

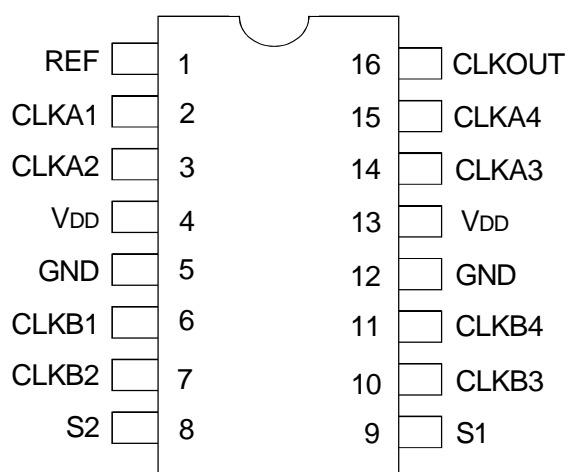
IDT23S09

The IDT23S09 is characterized for both Industrial and Commercial operation.

The diagram illustrates a clock distribution system. A reference signal (REF) is input to a phase-locked loop (PLL) block. The PLL output is distributed to four clock outputs: CLKOUT (pin 16), CLKA1 (pin 2), CLKA2 (pin 3), and CLKA3 (pin 14). Additionally, the PLL output is connected to a multiplexer that selects between the PLL output and a signal from the Control Logic block. The Control Logic block is also connected to the PLL and the multiplexer. The Control Logic block is driven by two inputs, S1 and S2, which are connected to pins 9 and 8, respectively. The Control Logic block outputs to four clock outputs: CLKB1 (pin 6), CLKB2 (pin 7), CLKB3 (pin 10), and CLKB4 (pin 11). The Control Logic block also outputs to the multiplexer.

1

PIN CONFIGURATION



SOIC/ TSSOP
TOP VIEW

APPLICATIONS:

- SDRAM
- Telecom
- Datacom
- PC Motherboards/Workstations
- Critical Path Delay Designs

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Rating	Max.	Unit
V _{DD}	Supply Voltage Range	-0.5 to +4.6	V
V _I ⁽²⁾	Input Voltage Range (REF)	-0.5 to +5.5	V
V _I	Input Voltage Range (except REF)	-0.5 to V _{DD} +0.5	V
I _{IK} (V _I < 0)	Input Clamp Current	-50	mA
I _O (V _O = 0 to V _{DD})	Continuous Output Current	±50	mA
V _{DD} or GND	Continuous Current	±100	mA
T _A = 55°C (in still air) ⁽³⁾	Maximum Power Dissipation	0.7	W
T _{STG}	Storage Temperature Range	-65 to +150	°C
Operating Temperature	Commercial Temperature Range	0 to +70	°C
Operating Temperature	Industrial Temperature Range	-40 to +85	°C

NOTES:

1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

PIN DESCRIPTION

Pin Name	Pin Number	Type	Functional Description
REF ⁽¹⁾	1	IN	Input reference clock, 5 Volt tolerant input
CLKA1 ⁽²⁾	2	Out	Output clock for bank A
CLKA2 ⁽²⁾	3	Out	Output clock for bank A
V _{DD}	4, 13	PWR	3.3V Supply
GND	5, 12	GND	Ground
CLKB1 ⁽²⁾	6	Out	Output clock for bank B
CLKB2 ⁽²⁾	7	Out	Output clock for bank B
S2 ⁽³⁾	8	IN	Select input Bit 2
S1 ⁽³⁾	9	IN	Select input Bit 1
CLKB3 ⁽²⁾	10	Out	Output clock for bank B
CLKB4 ⁽²⁾	11	Out	Output clock for bank B
CLKA3 ⁽²⁾	14	Out	Output clock for bank A
CLKA4 ⁽²⁾	15	Out	Output clock for bank A
CLKOUT ⁽²⁾	16	Out	Output clock, internal feedback on this pin

NOTES:

1. Weak pull down.
2. Weak pull down on all outputs.
3. Weak pull ups on these inputs.

FUNCTION TABLE⁽¹⁾

S2	S1	CLKA	CLKB	CLKOUT ⁽²⁾	Output Source	PLL Shut Down
L	L	Tri-State	Tri-State	Driven	PLL	N
L	H	Driven	Tri-State	Driven	PLL	N
H	L	Driven	Driven	Driven	REF	Y
H	H	Driven	Driven	Driven	PLL	N

NOTES:

- H = HIGH Voltage Level.
L = LOW Voltage Level
- This output is driven and has an internal feedback for the PLL. The load on this output can be adjusted to change the skew between the REF and the output.

DC ELECTRICAL CHARACTERISTICS - COMMERCIAL

Symbol	Parameter	Conditions		Min.	Max.	Unit
V _{IL}	Input LOW Voltage Level			—	0.8	V
V _{IH}	Input HIGH Voltage Level			2	—	V
I _{IL}	Input LOW Current	V _{IN} = 0V		—	50	μA
I _{IH}	Input HIGH Current	V _{IN} = V _{DD}		—	100	μA
V _{OL}	Output LOW Voltage	Standard Drive	I _{OL} = 8mA	—	0.4	V
		High Drive	I _{OL} = 12mA (-1H)			
V _{OH}	Output HIGH Voltage	Standard Drive	I _{OH} = -8mA	2.4	—	V
		High Drive	I _{OH} = -12mA (-1H)			
I _{DD_PD}	Power Down Current	REF = 0MHz (S2 = S1 = H)		—	12	μA
I _{DD}	Supply Current	Unloaded Outputs at 66.66MHz, SEL inputs at V _{DD} or GND		—	32	mA

OPERATING CONDITIONS - COMMERCIAL

Symbol	Parameter	Min.	Max.	Unit
V _{DD}	Supply Voltage	3	3.6	V
T _A	Operating Temperature (Ambient Temperature)	0	70	°C
C _L	Load Capacitance < 100MHz	—	30	pF
	Load Capacitance 100MHz - 133MHz	—	10	
C _{IN}	Input Capacitance	—	7	pF

SWITCHING CHARACTERISTICS (23S09-1) - COMMERCIAL^(1,2)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
t ₁	Output Frequency	10pF Load	10	—	133	MHz
		30pF Load	10	—	100	
	Duty Cycle = t ₂ ÷ t ₁	Measured at 1.4V, F _{OUT} = 66.66MHz	40	50	60	%
t ₃	Rise Time	Measured between 0.8V and 2V	—	—	2.5	ns
t ₄	Fall Time	Measured between 0.8V and 2V	—	—	2.5	ns
t ₅	Output to Output Skew	All outputs equally loaded	—	—	250	ps
t _{6A}	Delay, REF Rising Edge to CLKOUT Rising Edge ⁽²⁾	Measured at V _{DD} /2	—	0	±350	ps
t _{6B}	Delay, REF Rising Edge to CLKOUT Rising Edge ⁽²⁾	Measured at V _{DD} /2 in PLL bypass mode (IDT23S09 only)	1	5	8.7	ns
t ₇	Device-to-Device Skew	Measured at V _{DD} /2 on the CLKOUT pins of devices	—	0	700	ps
t ₁	Cycle-to-Cycle Jitter	Measured at 66.66MHz, loaded outputs	—	—	200	ps
t _{LOCK}	PLL Lock Time	Stable power supply, valid clock presented on REF pin	—	—	1	ms

NOTES:

- REF Input has a threshold voltage of V_{DD}/2.
- All parameters specified with loaded outputs.

SWITCHING CHARACTERISTICS (23S09-1H) - COMMERCIAL ^(1,2)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
t _f	Output Frequency	10pF Load	10	—	133	MHz
		30pF Load	10	—	100	
	Duty Cycle = t ₂ ÷ t ₁	Measured at 1.4V, F _{OUT} = 66.66MHz	40	50	60	%
	Duty Cycle = t ₂ ÷ t ₁	Measured at 1.4V, F _{OUT} < 50MHz	45	50	55	%
t _r	Rise Time	Measured between 0.8V and 2V	—	—	1.5	ns
t _f	Fall Time	Measured between 0.8V and 2V	—	—	1.5	ns
t _s	Output to Output Skew	All outputs equally loaded	—	—	250	ps
t _{6A}	Delay, REF Rising Edge to CLKOUT Rising Edge	Measured at V _{DD} /2	—	0	±350	ps
t _{6B}	Delay, REF Rising Edge to CLKOUT Rising Edge	Measured at V _{DD} /2 in PLL bypass mode (IDT23S09 only)	1	5	8.7	ns
t ₇	Device-to-Device Skew	Measured at V _{DD} /2 on the CLKOUT pins of devices	—	0	700	ps
t _s	Output Slew Rate	Measured between 0.8V and 2V using Test Circuit 2	1	—	—	V/ns
t _j	Cycle-to-Cycle Jitter	Measured at 66.66MHz, loaded outputs	—	—	200	ps
t _{LOCK}	PLL Lock Time	Stable power supply, valid clock presented on REF pin	—	—	1	ms

NOTES:

1. REF Input has a threshold voltage of V_{DD}/2.
2. All parameters specified with loaded outputs.

DC ELECTRICAL CHARACTERISTICS - INDUSTRIAL

Symbol	Parameter	Conditions		Min.	Max.	Unit
V _{IL}	Input LOW Voltage Level			—	0.8	V
V _{IH}	Input HIGH Voltage Level			2	—	V
I _{IL}	Input LOW Current	V _{IN} = 0V		—	50	μA
I _{IH}	Input HIGH Current	V _{IN} = V _{DD}		—	100	μA
V _{OL}	Output LOW Voltage	Standard Drive	I _{OL} = 8mA	—	0.4	V
		High Drive	I _{OL} = 12mA (-1H)			
V _{OH}	Output HIGH Voltage	Standard Drive	I _{OH} = -8mA	2.4	—	V
		High Drive	I _{OH} = -12mA (-1H)			
I _{DD_PD}	Power Down Current	REF = 0MHz (S2 = S1 = H)		—	25	μA
I _{DD}	Supply Current	Unloaded Outputs at 66.66MHz, SEL inputs at V _{DD} or GND		—	35	mA

OPERATING CONDITIONS - INDUSTRIAL

Symbol	Parameter	Min.	Max.	Unit
V _{DD}	Supply Voltage	3	3.6	V
T _A	Operating Temperature (Ambient Temperature)	-40	+85	°C
C _L	Load Capacitance < 100MHz	—	30	pF
	Load Capacitance 100MHz - 133MHz	—	10	
C _{IN}	Input Capacitance	—	7	pF

SWITCHING CHARACTERISTICS (23S09-1) - INDUSTRIAL ^(1,2)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
t _f	Output Frequency	10pF Load	10	—	133	MHz
		30pF Load	10	—	100	
	Duty Cycle = t ₂ ÷ t ₁	Measured at 1.4V, F _{OUT} = 66.66MHz	40	50	60	%
t ₃	Rise Time	Measured between 0.8V and 2V	—	—	2.5	ns
t ₄	Fall Time	Measured between 0.8V and 2V	—	—	2.5	ns
t ₅	Output to Output Skew	All outputs equally loaded	—	—	250	ps
t _{6A}	Delay, REF Rising Edge to CLKOUT Rising Edge	Measured at V _{DD} /2	—	0	±350	ps
t _{6B}	Delay, REF Rising Edge to CLKOUT Rising Edge	Measured at V _{DD} /2 in PLL bypass mode (IDT23S09 only)	1	5	8.7	ns
t ₇	Device-to-Device Skew	Measured at V _{DD} /2 on the CLKOUT pins of devices	—	0	700	ps
t _j	Cycle-to-Cycle Jitter	Measured at 66.66MHz, loaded outputs	—	—	200	ps
t _{LOCK}	PLL Lock Time	Stable power supply, valid clock presented on REF pin	—	—	1	ms

NOTES:

1. REF Input has a threshold voltage of V_{DD}/2.
2. All parameters specified with loaded outputs.

SWITCHING CHARACTERISTICS (23S09-1H) - INDUSTRIAL ^(1,2)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
t _f	Output Frequency	10pF Load	10	—	133	MHz
		30pF Load	10	—	100	
	Duty Cycle = t ₂ ÷ t ₁	Measured at 1.4V, F _{OUT} = 66.66MHz	40	50	60	%
	Duty Cycle = t ₂ ÷ t ₁	Measured at 1.4V, F _{OUT} <50MHz	45	50	55	%
t ₃	Rise Time	Measured between 0.8V and 2V	—	—	1.5	ns
t ₄	Fall Time	Measured between 0.8V and 2V	—	—	1.5	ns
t ₅	Output to Output Skew	All outputs equally loaded	—	—	250	ps
t _{6A}	Delay, REF Rising Edge to CLKOUT Rising Edge	Measured at V _{DD} /2	—	0	±350	ps
t _{6B}	Delay, REF Rising Edge to CLKOUT Rising Edge	Measured at V _{DD} /2 in PLL bypass mode (IDT23S09 only)	1	5	8.7	ns
t ₇	Device-to-Device Skew	Measured at V _{DD} /2 on the CLKOUT pins of devices	—	0	700	ps
t ₈	Output Slew Rate	Measured between 0.8V and 2V using Test Circuit 2	1	—	—	V/ns
t _j	Cycle-to-Cycle Jitter	Measured at 66.66MHz, loaded outputs	—	—	200	ps
t _{LOCK}	PLL Lock Time	Stable power supply, valid clock presented on REF pin	—	—	1	ms

NOTES:

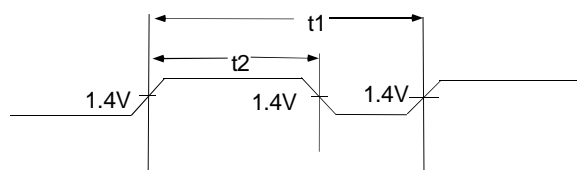
1. REF Input has a threshold voltage of V_{DD}/2.
2. All parameters specified with loaded outputs.

ZERO DELAY AND SKEW CONTROL

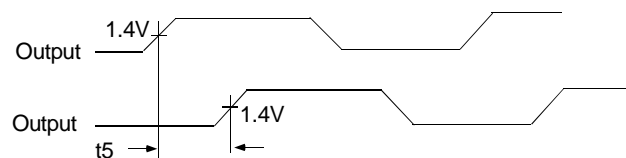
All outputs should be uniformly loaded in order to achieve Zero I/O Delay. Since the CLKOUT pin is the internal feedback for the PLL, its relative loading can affect and adjust the input/output delay. The Output Load Difference diagram illustrates the PLL's relative loading with respect to the other outputs that can adjust the Input-Output (I/O) Delay.

For designs utilizing zero I/O Delay, all outputs including CLKOUT must be equally loaded. Even if the output is not used, it must have a capacitive load equal to that on the other outputs in order to obtain true zero I/O Delay. For zero output-to-output skew, all outputs must be loaded equally.

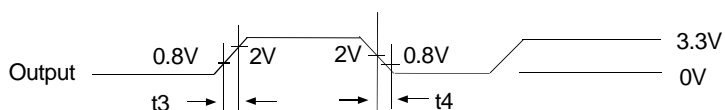
SWITCHING WAVEFORMS



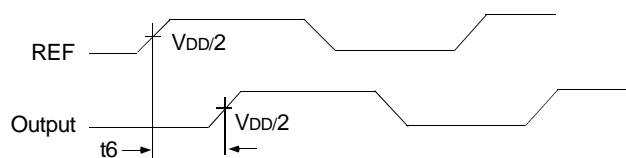
Duty Cycle Timing



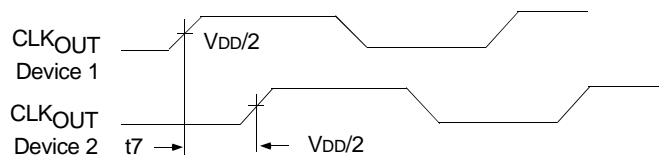
Output to Output Skew



All Outputs Rise/Fall Time

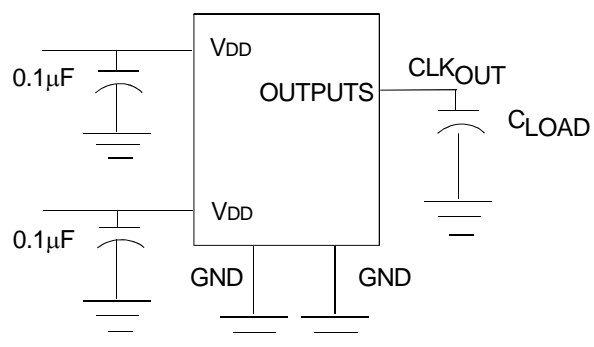


Input to Output Propagation Delay

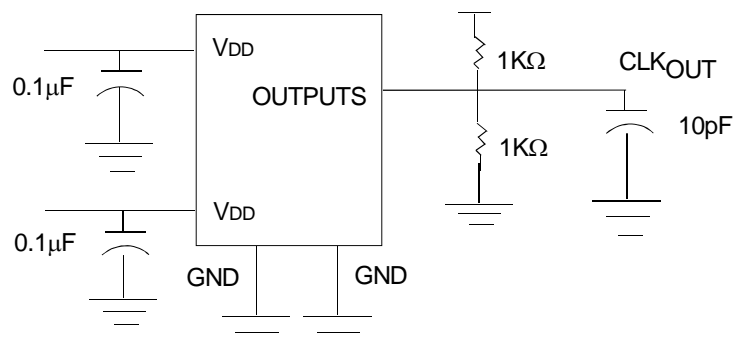


Device to Device Skew

TEST CIRCUITS



Test Circuit 1 (all Parameters Except t_8)



Test Circuit 2 (t_8 , Output Slew Rate On -1H Devices)

ORDERING INFORMATION

IDT	XXXXX	XX	X		
	Device Type	Package	Process		
				Blank	Commercial (0°C to +70°C) Industrial (-40°C to +85°C)
				I	
				DC	Small Outline
				PG	Thin Shrink Small Outline Package
				23S09-1	Zero Delay Clock Buffer with High Drive,
				23S09-1H	Spread Spectrum Compatible

Ordering Code	Package Type	Operating Range
IDT23S09-1DC	16-Pin SOIC	Commercial
IDT23S09-1DCI	16-Pin SOIC	Industrial
IDT23S09-1HDC	16-Pin SOIC	Commercial
IDT23S09-1HDCI	16-Pin SOIC	Industrial
IDT23S09-1HPG	16-Pin TSSOP	Commercial
IDT23S09-1HPGI	16-Pin TSSOP	Industrial



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